8/19/03

L11 ANSWER 1 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN
AB The wafers are manufd. by mixing Ga with Si raw materials and pulling up Si **single crystals** under conditions where whole surfaces of crystals in the diam. direction are N-regions, V-rich regions, or their mixed regions. The wafers are useful for **solar cells**. The obtained wafers show no formation of oxidn.-induced stacking faults and dislocation clusters.
ACCESSION NUMBER: 2002:422903 CAPLUS
DOCUMENT NUMBER: 137:13592
TITLE: **Gallium**-doped silicon **single crystal** wafers and their manufacture by **Czochralski** method
INVENTOR(S): Oki, Konomu
PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.
SOURCE: Jpn. Kokai Tokkyo Koho, 8 pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002160995	A2	20020604	JP 2000-359299	20001127

PRIORITY APPLN. INFO.: JP 2000-359299 20001127

=> d l11 1-13 abs ibib

L11 ANSWER 1 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN
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CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002160995	A2	20020604	JP 2000-359299	20001127

PRIORITY APPLN. INFO.: JP 2000-359299 20001127

L11 ANSWER 2 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN
AB The title Si crystal is doped with Ga and P. A **single crystal** is manufd. by **Czochralski** method from a Si melt added with Ga and P. Alternatively, a polycrystal is manufd. by Bridgman method from the melt. Also claimed is a wafer obtained by slicing the crystal. The wafer, esp. suitable for **solar cells**, is

manufd. at low cost and has high conversion efficiency.

ACCESSION NUMBER: 2002:264795 CAPLUS
DOCUMENT NUMBER: 136:282010
TITLE: Doped silicon crystal, its wafer, and manufacture of the crystal for **solar cell**
INVENTOR(S): Fujimaki, Nobuyoshi
PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.
SOURCE: Jpn. Kokai Tokkyo Koho, 10 pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002104898	A2	20020410	JP 2000-296022	20000928

PRIORITY APPLN. INFO.: JP 2000-296022 20000928

L11 ANSWER 3 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN
AB The title Si crystal is doped with Ga and B. A **single crystal** is manufd. by **Czochralski** method from a Si melt added with Ga and B. Alternatively, a polycrystal is manufd. by Bridgman method from the melt. Also claimed is a wafer obtained by slicing the crystal. The wafer, esp. suitable for **solar cells**, is manufd. at low cost and has high conversion efficiency.

ACCESSION NUMBER: 2002:264793 CAPLUS
DOCUMENT NUMBER: 136:282009
TITLE: Doped silicon crystal, its wafer, and manufacture of the crystal for **solar cell**
INVENTOR(S): Fujimaki, Nobuyoshi
PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.
SOURCE: Jpn. Kokai Tokkyo Koho, 10 pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002104897	A2	20020410	JP 2000-292087	20000926

PRIORITY APPLN. INFO.: JP 2000-292087 20000926

L11 ANSWER 4 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN
AB The **solar cell** has B and Ga dopants in a **single crystal** Si substrate. The **solar cell** is manufd. by drawing a **single crystal** B doped Si by the **Czochralski** method, prepg. a substrate from the **single crystal**, and diffusing Ga in the substrate.

ACCESSION NUMBER: 2002:220055 CAPLUS
DOCUMENT NUMBER: 136:234788
TITLE: **Solar cell** and its manufacture
INVENTOR(S): Kume, Fumitaka
PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.
SOURCE: Jpn. Kokai Tokkyo Koho, 7 pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002083981	A2	20020322	JP 2000-271420	20000907

PRIORITY APPLN. INFO.: JP 2000-271420 20000907

L11 ANSWER 5 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

AB A Ga-doped Si **single crystal** is manufd. by **Czochralski** method, wherein Al of amt. less than that of Ga is also added during the crystal growth. The manufd. Ga-doped Si **single crystal** is claimed. The Ga concn. may be (3 .times. 1015)-(5 .times. 1017) atoms/cm3. A **solar cell** employing the Si **single crystal** is also claimed. The crystal inhibits generation of heavy metal-derived OSF (oxidn.-induced stacking fault), so that the **solar cell** provides high and durable photoelec. conversion efficiency.

ACCESSION NUMBER: 2002:113783 CAPLUS
DOCUMENT NUMBER: 136:159187
TITLE: **Gallium**-doped silicon **single crystal** and its manufacture by **Czochralski** method, and silicon **single crystal solar cell**
INVENTOR(S): Tsuda, Nobuhiro
PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.
SOURCE: Jpn. Kokai Tokkyo Koho, 8 pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002047095	A2	20020212	JP 2000-231535	20000731

PRIORITY APPLN. INFO.: JP 2000-231535 20000731

L11 ANSWER 6 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

AB Ga-doped Si **single crystal** is manufd. from Si raw material contained in a crucible with 2-2.5 times diam. of the diam. of the manufg. **single crystal**. Thus manufd. crystal is also claimed. Ga-doped Si **single crystals** showing high energy efficiency when used in **solar cells** are manufd. at high pulling rate at low cost.

ACCESSION NUMBER: 2002:63422 CAPLUS
DOCUMENT NUMBER: 136:110345
TITLE: Ga-doped silicon **single crystals** and their manufacture by **Czochralski** process
INVENTOR(S): Oki, Yoshi; Iida, Makoto
PATENT ASSIGNEE(S): Shinetsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Industry Co., Ltd.
SOURCE: Jpn. Kokai Tokkyo Koho, 8 pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2002020192	A2	20020123	JP 2000-196706	20000629

PRIORITY APPLN. INFO.: JP 2000-196706 20000629

L11 ANSWER 7 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

AB This paper reports high-efficiency PERT (passivated emitter, rear totally-diffused) **solar cells** fabricated on a variety of **single cryst**. silicon substrates. The best cell efficiencies achieved are 21.9, 24.5, and 24.0% for Ga-doped **Czochralski** Si, B-doped magnetically confined **Czochralski** Si, and B-doped float-zone Si substrates, resp. The performance of all these cells is stable after illumination under 1-sun level. This is a result of avoiding using both high levels of boron and oxygen in the same material as occurs in B-doped **Czochralski** silicon **solar cells**, where large performance degrdn. is commonly obsd.

ACCESSION NUMBER: 2001:539756 CAPLUS
DOCUMENT NUMBER: 135:291253
TITLE: High efficiency PERT cells on a variety of **single crystalline** silicon substrates
AUTHOR(S): Zhao, Jianhua; Wang, Aihua; Green, Martin A.
CORPORATE SOURCE: Centre for Photovotaic Engineering, University of New South Wales, Sydney, NSW 2052, Australia
SOURCE: European Photovoltaic Solar Energy Conference, Proceedings of the International Conference, 16th, Glasgow, United Kingdom, May 1-5, 2000 (2000), Volume 2, 1100-1103. Editor(s): Scheer, Hermann. James & James (Science Publishers) Ltd.: London, UK.
CODEN: 69BOEK
DOCUMENT TYPE: Conference
LANGUAGE: English
REFERENCE COUNT: 6 THERE ARE 6 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L11 ANSWER 8 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN

AB A Si **single crystal** which is produced by **Czochralski** method and added with Ga as a dopant is characterized as having a resistivity of 5 .OMEGA..bul.cm to 0.1 .OMEGA..bul.cm; a wafer manufd. from the Si **single crystal**; and a method for producing a Si **single crystal** doped with Ga by **Czochralski** method are characterized in that the method comprises adding Ga to a Si melt in a crucible and then bringing the Si melt into contact with a seed crystal, and pulling up the seed crystal while rotating it, to thereby prep. a Si **single crystal** rod. The Si **single crystal**, although it has a high O concn. like a conventional Si **single crystal** by CZ method, can be used for manufg. a **solar cell** which is free from the deterioration caused by light and exhibits very high efficiency for the conversion of light energy.

ACCESSION NUMBER: 2000:861876 CAPLUS
DOCUMENT NUMBER: 134:11717
TITLE: Cz **single crystal** doped with Ga and wafer and method for production thereof
INVENTOR(S): Abe, Takao; Hirasawa, Teruhiko; Tokunaga, Katsushi; Igarashi, Tetsuya; Yamaguchi, Masafumi
PATENT ASSIGNEE(S): Shin-Etsu Handotai Co., Ltd., Japan; Shin-Etsu Chemical Co., Ltd.
SOURCE: PCT Int. Appl., 38 pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2000073542	A1	20001207	WO 2000-JP2850	20000428

W: AU, JP, KR, US
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL,

PT, SE
EP 1114885 A1 20010711 EP 2000-922915 20000428
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, FI
PRIORITY APPLN. INFO.: JP 1999-150697 A 19990528
JP 1999-264549 A 19990917
WO 2000-JP2850 W 20000428
REFERENCE COUNT: 13 THERE ARE 13 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L11 ANSWER 9 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN
AB Observations on deep levels introduced in silicon by 1 MeV electron irradn. are reported using boron- or **gallium**-doped **Czochralski** (CZ) grown Si space **solar cells** with different doping concns., deep level transient spectroscopy anal. has been carried out to detect the radiation-induced deep levels. Present results provide evidence for new defect states in addn. to those previously reported in **gallium**- and boron-doped Si. The combined boron and **gallium** data provide enough information to gain valuable insight into the role of the dopants on radiation induced defects in Si. The dominant donor-like electron level at EC-0.18 eV in boron-doped Si has not been obsd. in **gallium**-doped CZ-grown Si. A noticeable suppressing generation of the radiation-induced defects in **gallium**-doped Si is also obsd., esp. hole level EV+0.36 eV, which is thought to acts as a recombination center.
ACCESSION NUMBER: 2000:371176 CAPLUS
DOCUMENT NUMBER: 133:113054
TITLE: Influence of the dopant species on radiation-induced defects in Si **single crystals**
AUTHOR(S): Khan, Aurangzeb; Yamaguchi, Masafumi; Kaneiwa, Minoru; Saga, Tatsue; Abe, Takao; Annzawa, Osamu; Matsuda, Sumio
CORPORATE SOURCE: Toyota Technological Institute, Tempaku, Nagoya, 468-8511, Japan
SOURCE: Journal of Applied Physics (2000), 87(12), 8389-8392
CODEN: JAPIAU; ISSN: 0021-8979
PUBLISHER: American Institute of Physics
DOCUMENT TYPE: Journal
LANGUAGE: English
REFERENCE COUNT: 14 THERE ARE 14 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L11 ANSWER 10 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN
AB A simple, vertical-dipping, liq.-phase epitaxy (LPE) method for growth of Si layers from Cu/Si soln. at temps. less than 950.degree. has been shown to be a promising technique for thin cryst. Si photovoltaic (PV) applications. **Solar cells** with more than 15% AM1 efficiency were fabricated on 5-.mu.m-thick layers grown from Cu/Si soln. on (111) **Czochralski** (CZ) substrates. To extend the application of this technique to low-cost substrates, we grew thin (5-40 .mu.m) Si layers on cast multicryst. metallurgical-grade (MG) substrates from Cu/Si soln. as well as from Al/Si, Al/Cu/Si, Bi/Si, Ga/Cu/Si, and Sn/Si solns. The conditions of growth, morphol., solvent incorporation characteristics and problems that arise with the use of multicryst. Si substrates are discussed. A diagnostic **solar cell** with efficiency equal to 0.42 and open-circuit voltage equal to 0.89 of the values for a **single crystal** control cell was obtained, without any light-trapping scheme, on a 15-.mu.m-thick layer grown on a MG Si substrate.
ACCESSION NUMBER: 1995:75199 CAPLUS
DOCUMENT NUMBER: 122:218427
TITLE: Si thin layer growth from metal solutions on **single-crystal** and cast metallurgical-grade multicrystalline Si substrates

AUTHOR(S): Ciszek, T. F.; Wang, T. H.; Wu, X.; Burrows, R. W.; Alleman, J.; Schwerdtfeger, C. R.; Bekkedahl, T.
CORPORATE SOURCE: National Renewable Energy Laboratory, Golden, CO, 80401, USA
SOURCE: Conference Record of the IEEE Photovoltaic Specialists Conference (1993), 23rd, 65-72
CODEN: CRCNDP; ISSN: 0160-8371
DOCUMENT TYPE: Journal
LANGUAGE: English

L11 ANSWER 11 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN
AB A review with 157 refs. The established technologies of Si, CdS/Cu2S, and GaAs cells are examd. in terms of manufg. processes, advantages, disadvantages, efficiencies, applications, and further reading. Several emerging technologies are then treated including the heat-exchange method, the edge-defined film-fed growth ribbon process, the dendritic web growth process, advanced **Czochralski** processes, alternative methods of fabricating cells from **single-crystal** Si such as ion implantation and metal-insulator-semiconductor junctions, polycryst. Si cells, amorphous Si cells, CdS/CuInSe2 cells, GaAs cells, and photoelectrochem. cells. Advanced concepts such as multijunction cells, emerging semiconductor materials, and org. cells are treated. Concentrator systems and cells designed specifically for high light levels are analyzed and assessed as to com. viability.
ACCESSION NUMBER: 1983:615620 CAPLUS
DOCUMENT NUMBER: 99:215620
TITLE: **Solar cells** - a technology assessment
AUTHOR(S): Bolton, James R.
CORPORATE SOURCE: Dep. Chem., Univ. West. Ontario, London, ON, N6A 5B7, Can.
SOURCE: Solar Energy (1983), 31(5), 483-502
CODEN: SRENA4; ISSN: 0038-092X
DOCUMENT TYPE: Journal; General Review
LANGUAGE: English

L11 ANSWER 12 OF 13 CAPLUS COPYRIGHT 2003 ACS on STN
AB A method is described for cheaply growing **single-crystal** sheets with duplicate surface textures from polycryst. or amorphous Ge, Si, and GaAs for **solar cells** and CdTe and (Hg,Cd)Te for IR detectors. A **single-crystal** wafer is 1st texture etched to a depth of 0.5-10 .mu., a stratum of a release compn. (Al, Ni, Mo, W, C, Ti, and their alloys and compds.) is deposited by vapor deposition to a depth of 0.1-10 .mu., a metal or glass support is attached to the release stratum to provide mech. strength, the release stratum is sepd. from the wafer by raising the temp. and inverted to form a replica master, a replica stratum of amorphous or polycryst. structure is deposited on the replica master to a depth of .apprx.1 .mu., the replica stratum is grown into a **single-crystal** layer by pulsed irradn. (laser or electron beam) in a master scan, and the crystal layer is sepd. for use. The replica master can be reused or used to produce other replica masters. Thus, a **Czochralski**-grown Si (100) wafer was etched with KOH to a depth of 2 .mu., an .apprx.10-.mu. thick Al release stratum was deposited by evapn., a support of 1/8-in. thick borosilicate glass was electrostatically bonded to the Al, the temp. was raised to 250 .degree.F to release the Al, amorphous Si was deposited on the Al by chem. vapor deposition, the amorphous Si was irradiated with a 12-keV pulsed electron beam and transformed to a **single crystal**, several other layers of amorphous Si were deposited and irradiated until a **single crystal** 10-30 .mu. thick was formed, and the new Si wafer was sepd. and formed into a p-n junction **solar cell** by ion implantation.
ACCESSION NUMBER: 1982:606179 CAPLUS
DOCUMENT NUMBER: 97:206179

TITLE: **Single crystal** processes and products
INVENTOR(S): Little, Roger G.
PATENT ASSIGNEE(S): Spire Corp., USA
SOURCE: U.S., 7 pp.
CODEN: USXXAM
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 4350561	A	19820921	US 1980-150331	19800516

PRIORITY APPLN. INFO.: US 1980-150331 19800516

L11 ANSWER 13 OF 13 INSPEC (C) 2003 IEE on STN
AN 2000:6612530 INSPEC DN A2000-14-7155-008; B2000-07-2520C-023
AB Observations on deep levels introduced in **silicon** by 1 MeV electron irradiation are reported using boron- or **gallium**-doped **Czochralski** (CZ) grown Si space **solar cells** with different doping concentrations, deep level transient spectroscopy analysis has been carried out to detect the radiation-induced deep levels. Present results provide evidence for new defect states in addition to those previously reported in **gallium**- and boron-doped Si. The combined boron and **gallium** data provide enough information to gain valuable insight into the role of the dopants on radiation induced defects in Si. The dominant donor-like electron level at EC-0.18 eV in boron-doped Si has not been observed in **gallium**-doped CZ-grown Si. A noticeable suppressing generation of the radiation-induced defects in **gallium**-doped Si is also observed, especially hole level EV+0.36 eV, which is thought to acts as a recombination center.
DOCUMENT NUMBER: A2000-14-7155-008; B2000-07-2520C-023
TITLE: Influence of the dopant species on radiation-induced defects in Si **single crystals**.
AUTHOR: Khan, A.; Yamaguchi, M. (Toyota Technol. Inst., Nagoya, Japan); Kaneiwa, M.; Saga, T.; Abe, T.; Annzawa, O.; Matsuda, S.
SOURCE: Journal of Applied Physics (15 June 2000) vol.87, no.12, p.8389-92. 14 refs.
Doc. No.: S0021-8979(00)05212-9
Published by: AIP
Price: CCCC 0021-8979/2000/87(12)/8389(4)/$17.00
CODEN: JAPIAU ISSN: 0021-8979
SICI: 0021-8979(20000615)87:12L.8389:IDSR;1-V
DOCUMENT TYPE: Journal
TREATMENT CODE: Practical; Experimental
COUNTRY: United States
LANGUAGE: English

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L13 ANSWER 30 OF 32 CAPLUS COPYRIGHT 2002 ACS
AN 1985:223339 CAPLUS
DN 102:223339
TI Irradiated **solar cells** fabricated from **gallium** -doped/boron-**doped** FZ and CZ **silicon**
AU Minahan, Joseph A.; Neal, N.; Dionne, D.; Taylor, William E.; Trumble, Terry M.
CS Spectrolab, Inc., Sylmar, CA, 91342, USA
SO Conf. Rec. IEEE Photovoltaic Spec. Conf. (1982), 16th, 310-15
CODEN: CRCNDP; ISSN: 0160-8371
DT Journal
LA English
CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)
AB The tolerance to various fluence levels of 1-MeV electrons of **solar cells** fabricated from Ga- and B-doped multipass FZ (float-zone) Si, and Ga- and B-doped crucible-grown (CZ) Si was compared. The FZ materials used for the study were of ultrahigh purity with low levels of O and C. Bulk anal. of Ga-doped CZ Si is included and compared with Ga-doped FZ Si. Bulk anal. of selected wafers in the various **crystals** was performed by low-temp. Fourier-transform IR and surface photovoltage. Measurement of air-mass-0 elec. characteristics and spectral response of **solar cells** fabricated from these Si materials before and after 1-MeV electron irradn. are used to compare radiation tolerance of the materials.
ST electron irradn silicon **solar cell**; **gallium doped silicon solar cell**; boron doped silicon **solar cell**
IT Electron beam, chemical and physical effects
(on boron- and **gallium-doped silicon solar cells**)
IT Photoelectric devices, solar
(**silicon**, boron- and **gallium-doped** float-zone and crucible-grown, electron irradn. of)
IT 7440-42-8, uses and miscellaneous 7440-55-3, uses and miscellaneous
RL: USES (Uses)
(photoelec. **solar cells** from silicon doped with, float-zone and crucible-grown, electron irradn. of)
IT 7440-21-3, uses and miscellaneous
RL: USES (Uses)
(photoelec. **solar cells**, boron- and gallium-doped float-zone and crucible-grown, electron irradn. of)